Programming Guide

RIGOL

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DG2000 Series Function/Arbitrary Waveform Generator

DG2041A，DG2021A

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Document Overview

This book provides guidance to the remote control programming of **RIGOL** DG2000 series digital generator. Readers of this book should have read "User's Guide for DG2000 Series Function/ Arbitrary Waveform Generator" and be familiar with the operation of the generator.

This book includes the following chapters:

- Chapter 1 summarizes how to use the commands.
- Chapter 2 detailedly introduces the commands.
- Chapter 3 gives application examples for how to use the commands.
- The Appendix lists all the commands alphabetically in favor of quick reference.

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Chapter 1 General Comments

This chapter includes the following sections:

- Programming Introduction
- Symbol Description
- Commands Abbreviation

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Programming Introduction

Computers communicate with the generator by sending and receiving messages over an I/O port, such as USB, GPIB port or a RS-232 port. Commands appear in the form of ASCII character strings embedded inside the output statements of a "host" language available on your computer.

Basic operations that you can do with a computer and an oscilloscope include:

- Set up the generator.
- Generate waveforms data.

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Symbol Description

1. Colons :

":" is used to separate the keywords from subbordinate keywords for commands, it denotes the operation to be performed by Generator.

2. Space □

Space □ is used to separate the keywords from program data in the line of instruction. If the instruction does not contain any datum, space is needless.

3. Question mark ?

A query mark (?) appends to the end of an instruction denotes to query its function. Generally a query instruction is made up of different datum that is separated from instruction via Space. But there are also many query instructions do not need data.

4. Braces { }

When several items are enclosed by braces { }, only one of these elements may be selected. Vertical line | indicates "or". For example, {ON | OFF} indicates that only ON or OFF may be selected, not both.

5. Square brackets [ ]

Items enclosed in square brackets [ ] are optional.

6. Cuspate brackets < >

Items enclosed in cuspate brackets< >must be substituted with a value.

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Commands Abbreviation

In this system, as some commands are too long to memory and spell, we set the abbreviation of the commands in order to reduce your workload.

Abbreviating rules:
All the small letters within the instrucation header could be omited.

For example:

VOLTage□3.0

can be entered as

VOLT□3.0

NOTE:
All the comands are not sensitive to both capital letter and lowercase.

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Chapter 2 Commands System

This chapter detailedly introduces the commands system of DG2000 series function/arbitrary waveform generator. Each command and corresponding parameters would be explaned in order to make you master its application as soon as possible.

The Subcommands of DG2000 include:

- APPLy
- FUNCtion
- FREQency
- VOLTage
- OUTPut
- PULSe
- AM
- FM
- PM
- PWM
- FSKey
- SWEep
- TRIGger
- BURSt
- UNIT
- DATA
- MEMory
- SYSTem
- PHASe
- CALibration
- DISPlay

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APPLy

APPLy commands provide the most straightforward method to program the generator over remote interface. The instrument will output the waveform as soon as the OUTPUT has been turned on.

APPLy commands include:

- APPLy:SINusoid
- APPLy:SQUare
- APPLy:RAMP
- APPLy:PULSe
- APPLy:NOISe
- APPLy:DC
- APPLy:USER
- APPLy?

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1. APPLy:SINusoid

Syntax:
APPLy:SINusoid□[<frequency> [,<amplitude> [,<offset>]]]

Description:
This command is used for generating a sine wave with specified frequency, amplitude, and dc offset.

Remarks:
- <frequency>, <amplitude>, <offset> are optional, the default unit are: Hz,Vpp,Vdc.
- When the parameters you set are less than three, the sequence woulde be: <frequency>, <amplitude>, <offset>.
- If not parameters are set, the instrument will output current parameters and unit.

Example:
To generate a sine wave with 1kHz frequency, 5Vpp amplitude and 0Vdc offset:
APPL:SIN□1000,5,0

2. APPLy:SQUare

Syntax:
APPLy:SQUare□[<frequency> [,<amplitude> [,<offset>]]]

Description:
This command is used for generating a square wave with specified frequency, amplitude, and dc offset.

Example:
To generate a square wave with 1kHz frequency, 5Vpp amplitude and 0Vdc offset:
APPL:SQU□1000,5,0

3. APPLy:RAMP

Syntax:
APPLy:RAMP□[<frequency> [,<amplitude> [,<offset>]]]

Description:
This command is used for generating a ramp wave with specified frequency, amplitude, and dc offset.

Example:
To generate a ramp wave with 1kHz frequency, 5Vpp amplitude and 0Vdc offset:
APPL:RAMP□1000,5,0

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4. APPLy:PULSe

Syntax:
APPLy:PULSe□[<frequency> [,<amplitude> [,<offset>]]]

Description:
This command is used for generating a pulse wave with specified frequency, amplitude, and dc offset.

Example:
To generate a pulse wave with 1kHz frequency, 5Vpp amplitude and 0Vdc offset:
APPL:PULS□1000,5,0

5. APPLy:NOISe

Syntax:
APPLy:NOISe□[<frequency|DEFault> [,<amplitude> [,<offset>]]]

Description:
This command is used for generating Gaussian noise with specified amplitude and dc offset.

Remarks:
- The <frequency> parameter has no effect for this command but you must specify a value or a "DEFault" (the noise function has a 20 MHz bandwidth).
- If you specify a frequency, it has no effect for the noise output, but the value is remembered when you change another function.

Example:
To generate a noise with 5Vpp amplitude and 0Vdc offset:
APPL:NOIS DEF, 5, 0

6. APPLy:DC

Syntax:
APPLy:DC□[<frequency|DEFault> [,<amplitude|DEFault> [,<offset>]]]

Description:
This command is used for generating a dc voltage with the level specified by offset parameter.

Remarks:
- The <frequency> and <amplitude> parameters have no effect for this command but you must specify a value or "DEFault".
- If you specify a frequency and amplitude, they have no effect for the dc output, but the values are remembered when you change another function.

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Example:
To generate a DC with -1.5Vpp offset:
APPL:DC□DEF, DEF, -1.5

7. APPLy:USER

Syntax:
APPLy:USER□[<frequency> [,<amplitude> [,<offset>]]]

Description:
This command is used for generating arbitrary waveform currently selected by the FUNC:USER command with specified frequency, amplitude, and dc offset.

Example:
To generate a arbitrary wave with 1kHz frequency, 5Vpp amplitude and 0Vdc offset:
APPL:USER□1000,5,0

8. APPLy?

Syntax:
APPLy?

Description:
- Query the generator's current configuration and return a quoted string.
- The purpose of this command is to allow you to append this query response to an APPL: command in your programming application and use the result to place the generator in the specified state.

Return Format:
The function, frequency, amplitude, and offset are returned (the quotation marks are returned as part of the string) such as:

"SIN,1.000000e+03,5.000000e+00,0.000000e+00"

When the function is DC, the following string will be returned:
",1.000000e+03,5.000000e+00,0.000000e+00"

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FUNCtion

FUNCtion commands are used for choosing the output function and their parameters; selecting carrier wave in the modulation; choosing one of the five built-in arbitrary waveforms, one of four user-defined waveforms, or the waveform currently downloaded to volatile memory.

FUNCtion commands include:

- FUNCtion
- FUNCtion?
- FUNCtion:USER
- FUNCtion:USER?
- FUNCtion:SQUare:DCYCle
- FUNCtion:SQUare:DCYCle?
- FUNCtion:RAMP:SYMMetry
- FUNCtion:RAMP:SYMMetry?

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1. FUNCtion

Syntax:
FUNCtion□{SINusoid | SQUare | RAMP | PULSe | NOISe | DC | USER}
FUNCtion?

Description:
- Select the output function.
- Query the selected function.

Return Format:
The query returns SIN, SQU, RAMP, PULS, NOIS, DC or USER. The default is SIN.

Example:

FUNC□SIN	Choose sine ware
FUNC?	Retrun "SIN"

2. FUNCtion:USER

Syntax:
FUNCtion:USER□{<arb name> | VOLATILE}
FUNCtion:USER?

Description:
- Select one of the five built-in arbitrary waveforms and one of the four user-defined waveforms, or the waveform currently downloaded to volatile memory.
- Query the selected waveform name.

Return Format:
The query returns EXP_RISE,EXP_FALL, NEG_RAMP, SINC, CARDIAC, VOLATILE or the name of any user-defined waveforms in non-volatile memory. The default selection is EXP_RISE.

Example:

FUNC:USER□VOLATILE	Choose waveform stored in volatile memory.
FUNC:USER?	Retrun "VOLATILE"

3. FUNCtion:SQUare:DCYCle

Syntax:
FUNCtion:SQUare:DCYCle□{<percent> | MINimum | MAXimum}
FUNCtion:SQUare:DCYCle?□[MINimum | MAXimum]

Description:
Set or query the duty cycle percentage for square waves. The default is 50%.

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Remarks:

- MIN selects the minimum duty cycle for the selected frequency and MAX selects the maximum duty cycle.
- Different frequency has different duty cycle upper/lower limit:
  ≤ 8MHz: 20%~80%
  8MHz~16MHz: 40%~60%
  >16MHz: 50%

Return Format:

The query returns the current duty cycle setting in percent.

Example:

FUNC:SQU:DCYC□MIN	Set the minimum duty cycle under current frewuency.
FUNC:SQU:DCYC?	Return the set duty cycle.

4. FUNCtion:RAMP:SYMMetry

Syntax:

FUNCtion:RAMP:SYMMetry□{<percent> | MINimum | MAXimum}
FUNCtion:RAMP:SYMMetry?□[MINimum | MAXimum]

Description:

Set or query the symmetry percentage for ramp waves.

Remarks:

You can set the symmetry from 0% to 100%.

Return Format:

The query returns the current symmetry setting in percent.

Example:

FUNC:RAMP:SYMM□MIN	Set the symmetry to be 0%
FUNC:RAMP:SYMM?	Return 0.000000

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FREQuency

FREQuency commands are used for setting the frequency of the function, the start and stop frequency, the center frequency or the span frequency in sweep mode.

FREQuency commands include:

- FREQuency
- FREQuency?
- FREQuency:STARt
- FREQuency:STARt?
- FREQuency:STOP
- FREQuency:STOP?
- FREQuency:CENTer
- FREQuency:CENTer?
- FREQuency:SPAN
- FREQuency:SPAN?

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1. FREQuency

Syntax:
FREQuency□{<frequency>| MINimum | MAXimum}
FREQuency?□[MINimum | MAXimum]

Description:
Set or query the output frequency.

Remarks:
MIN selects the lowest frequency allowed by selected function and MAX selects the highest frequency allowed. The default is 1 kHz for all functions.

Return Format:
The query returns the frequency setting in hertz for the function currently selected.

Example:

FREQ□MIN	Set the output frequency to the minimum.
FREQ?	Retrun the set frequency.

2. FREQuency:STARt

Syntax:
FREQuency:STARt□{< frequency > | MINimum | MAXimum}
FREQuency:STARt?□[MINimum | MAXimum]

Description:
Set or query the start frequency (used in conjunction with the stop frequency).

Return Format:
The query returns the start frequency in hertz.

Example:

FREQ:STAR□MIN	Set the start frequency to the minimum.
FREQ:STAR?	Retrun the set start frequency.

3. FREQuency:STOP

Syntax:
FREQuency:STOP□{< frequency > | MINimum | MAXimum}
FREQuency:STOP?□[MINimum | MAXimum]

Description:
Set or query the stop frequency (used in conjunction with the start frequency).

Return Format:

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The query returns the stop frequency in hertz.

Example:

FREQ:STOP□MIN Set the stop frequency to the minimum.
FREQ:STOP? Retrun the set stop frequency.

4. FREQuency:CENTer

Syntax:

FREQuency:CENTer□{< frequency > | MINimum | MAXimum}
FREQuency:CENTer?□[MINimum | MAXimum]

Description:

Set or query the center frequency (used in conjunction with the frequency span).

Return Format:

The query returns the center frequency in hertz.

Example:

FREQ:CENT□MIN Set the center frequency to the minimum.
FREQ:CENT? Retrun the set center frequency.

5. FREQuency:SPAN

Syntax:

FREQuency:SPAN□{< frequency > | MINimum | MAXimum}
FREQuency:SPAN?□[MINimum | MAXimum]

Description:

Set or query the frequency span (used in conjunction with the center frequency).

Return Format:

The query returns the frequency span in hertz.

Example:

FREQ:SPAN□MIN Set the frequency span to the minimum.
FREQ:SPAN? Retrun the set frequency span.

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VOLTage

VOLTage commands are used for setting the output of the voltage amplitude, offset, high level, low level, or setting the voltage range auto adjustment and the voltage unit.

VOLTage commands include:

- VOLTage
- VOLTage?
- VOLTage:HIGH
- VOLTage:HIGH?
- VOLTage:LOW
- VOLTage:LOW?
- VOLTage:OFFSet
- VOLTage:OFFSet?
- VOLTage:UNIT
- VOLTage:UNIT?

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1. VOLTage

Syntax:
VOLTage□{<amplitude >| MINimum | MAXimum}
VOLT?□[MINimum | MAXimum]

Description:
Set or query the output amplitude.

Remarks:
- MIN selects the smallest amplitude. MAX selects the largest amplitude for the selected function.
- You can changed the unit by **VOLTage:UNIT** command, the defaut is Vpp.

Return Format:
The query returns the output amplitude for the function currently selected.

Example:
VOLT□MIN Set the output amplitude to the minimum.
VOLT? Return the set amplitude.

2. VOLTage:HIGH

Syntax:
VOLTage:HIGH□{<voltage > | MINimum | MAXimum}
VOLTage:HIGH?□[MINimum | MAXimum]

Description:
Set or query the output high level.

Return Format:
The query returns the specified high level.

Example:
VOLT:HIGH□MIN Set the high level to the minimum.
VOLT:HIGH? Return the set high level.

3. VOLTage:LOW

Syntax:
VOLTage:LOW□{<voltage > | MINimum | MAXimum}
VOLTage:LOW?□[MINimum | MAXimum]

Description:
Set or query the output low level.

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Return Format:
The query returns the specified low level.

Example:
VOLT:LOW□MIN Set the low level as the minimum.
VOLT:LOW? Return the set low level.

4. VOLTage:OFFSet

Syntax:
VOLTage:OFFSet□{<offset> | MINimum | MAXimum}
VOLTage:OFFSet?

Description:
Set or query the dc offset voltage.

Remarks:
- The default offset is 0 volts for all functions.
- MIN selects the most negative dc offset voltage for the selected function and amplitude. MAX selects the largest dc offset for the selected function and amplitude.

Return Format:
The query returns the offset voltage for the function currently selected.

Example:
VOLT:OFFS□MIN Set the dc offset to the minimum.
VOLT:OFFS? Return the set dc offset.

5. VOLTage:UNIT

Syntax:
VOLTage:UNIT□{VPP | VRMS | DBM}
VOLTage:UNIT?

Description:
Set or query the unit of the output voltage.

Return Format:
The query returns VPP、VRMS or DBM.

Example:
VOLT:UNIT□VPP Set the unit to VPP
VOLT:UNIT? Return VPP

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OUTPut

OUTPut commands are used for setting the output, such as: the output control, the output terminal, the polarity of the waveform, the synchronous output signal and the trigger output.

OUTPut commands include:

- OUTPut
- OUTPut?
- OUTPut:LOAD
- OUTPut:LOAD?
- OUTPut:POLarity
- OUTPut:POLarity?
- OUTPut:SYNC
- OUTPut:SYNC?
- OUTPut:TRIGger:SLOPe
- OUTPut:TRIGger:SLOPe?
- OUTPut:TRIGger
- OUTPut:TRIGger?

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1. OUTPut

Syntax:
OUTPut□{OFF | ON}
OUTPut?

Description:
- Disable or enable the front-panel Output connector. The default is "OFF".
- Query the state of the OUTPUT connector on the front panel.

Return Format:
The query returns OFF or ON.

Example:

OUTP□ON	Enable the OUTPUT connector.
OUTP?	Return ON.

2. OUTPut:LOAD

Syntax:
OUTPut:LOAD□{<ohms> | INFinity | MINimum | MAXimum}
OUTPut:LOAD?□[MINimum | MAXimum]

Description:
- Select the desired output termination. The specified value is used for amplitude, offset, and high/low level settings.
- Query the setting of the output termination.

Return Format:
The query returns the current load setting in ohms.

Example:

OUTP:LOAD□MAX	Set the output load to the maximum.
OUTP:LOAD?	Return the set value of the output load.

3. OUTPut:POLarity

Syntax:
OUTPut:POLarity□{NORMal | INVerted}
OUTPut:POLarity?

Description:
Set or query the output polarity.

Remarks:
- In the normal mode (default), the waveform goes positive during the first part of

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the cycle.

- In the inverted mode, the waveform goes negative during the first part of the cycle.

Return Format:
The query returns "NORM" or "INV".

Example:
OUTP:POL□NORM Set the polarity to NORMal.
OUTP:POL? Return NORM.

4. OUTPut:SYNC

Syntax:
OUTPut:SYNC□{OFF | ON}
OUTPut:SYNC?

Description:
- Disable or enable the front-panel Sync connector. The default setting is "ON".
- Query the state of the Sync connector.

Return Format:
The query returns OFF or ON.

Example:
OUTP:SYNC□ON Enable the Sync connector.
OUTP:SYNC? Return SYNC ON.

5. OUTPut:TRIGger:SLOPe

Syntax:
OUTPut:TRIGger:SLOPe□{POSitive | NEGative}
OUTPut:TRIGger:SLOPe?

Description:
Select or query the edge for the "trigger out" signal.

Remarks:
- The default is POS.
- Select "POS" to output a pulse with a rising edge or select "NEG" to output a pulse with a falling edge.

Return Format:
The query returns "POS" or "NEG".

Example:
OUTP:TRIG:SLOP□POS Choose the rise edge.

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OUTP:TRIG:SLOP? Return POS

6. OUTPut:TRIGger

Syntax:
OUTPut:TRIGger:SLOPe□{ON | OFF}
OUTPut:TRIGger?

Description:
- Enable or disable the trigger output.
- Query the state of the trigger output.

Return Format:
The query returns "ON" or "OFF".

Example:
OUTP:TRIG:SLOP□ON Enable the trigger output.
OUTP:TRIG? Return ON.

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PULSe

PULSe commands are used for setting the Pulse wave, such as: the period, pulse width and transition time.

PULSes commands include:

- PULSe:PERiod
- PULSe:PERiod?
- PULSe:WIDTh
- PULSe:WIDTh?
- PULSe:TRANsition
- PULSe:TRANsition?

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1. PULSe:PERiod

Syntax:
PULSe:PERiod□{<seconds> | MINimum | MAXimum}
PULSe:PERiod?□[MINimum | MAXimum]

Description:
Set or query the period for pulse.

Return Format:
The query returns the period of the pulse waveform in seconds.

Example:

PULS:PER□MIN	Set the pulse period to the minimum.
PULS:PER?	Return the set pulse period.

2. PULSe:WIDTh

Syntax:
PULSe:WIDTh□{<seconds > | MINimum | MAXimum}
PULSe:WIDTh?□[MINimum | MAXimum]

Description:
Set or query the pulse width in seconds.

Remarks:
Pulse width depends on the pulse period.

Return Format:
The query returns the pulse width in seconds.

Example:

PULS:WIDT□MIN	Set the pulse width to the minimum.
PULS:WIDT?	Return the set pulse width.

3. PULSe:TRANsition

Syntax:
PULSe:TRANsition□{<seconds> | MINimum | MAXimum}
PULSe:TRANsition?□[MINimum | MAXimum]

Description:
- Set the edge time in seconds for both the rising and falling edges.
- Query the edge time.

Return Format:

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The query returns the edge time in seconds.

Example:

PULS:TRAN□MIN Set the edge time to the minimum.
PULS:TRAN? Return the set edge time.

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AM

In AM, the amplitude of the carrier is varied by the instantaneous voltage of the modulating waveform. The generator will accept an internal or external modulation source.

To generate an AM waveform you have to configure the carrier wave, choose the modulation source, select the modulation wave and its frequency, set the modulation depth, and then enable the AM modulation.

AM commands include:

- AM:SOURce
- AM:SOURce?
- AM:INTernal:FUNCtion
- AM:INTernal:FUNCtion?
- AM:INTernal:FREQuency
- AM:INTernal:FREQuency?
- AM:DEPTh
- AM: DEPTh?
- AM:STATE
- AM:STATE?

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1. AM:SOURce

Syntax:
AM:SOURce□{INTernal | EXTernal}
AM:SOURce?

Description:
- Select the source of the modulating signal. The generator will accept an internal or external modulation source. The default is INT.
- Query the selected AM modulation source.

Return Format:
The query returns INT or EXT.

Example:
AM:SOUR□EXT Choose external modulation source.
AM:SOUR? Return EXT.

2. Select AM carrier wave

Syntax:
FUNCtion□{SINusoid | SQUare | RAMP | USER}

Description:
Select the AM carrier wave: Sine, Square, Ramp, or Arbitrary waveform. The default is Sine.

Remarks:
Pulse, Noise and DC cannot be used as AM carrier wave.

Related command:
FUNCtion

3. Set the carrier frequency

Syntax:
FREQuency□{<frequency> | MINimum | MAXimum}

Description:
Set the carrier frequency. MAX depends on the carrier wave function, MIN is always 1kHz.

Related commands:
FUNCtion
FREQuency

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4. AM:INTernal:FUNCtion

Syntax:
AM:INTernal:FUNCtion□{SINusoid | SQUare | RAMP | NRAMp | TRIangle | NOISe | USER}
AM:INTernal:FUNCtion?

Description:
Select or query the shape of the modulating waveform.

Remarks:
- The modulating waveform can be "SIN", "SQU", "RAMP", "NRAM", "TRI", "NOIS", or "USER" when the internal modulation source is selected. The default is SIN
- If the external source is chosen, it also can be used for modulating the carrier wave.

Return Format:
The query returns SIN, SQU, RAMP, NRAM, TRI, NOIS or USER.

Example:

AM:INT:FUNC□USER	Select arbitrary waveform as the modulating waveform
AM:INT:FUNC?	Query returns USER

5. AM:INTernal:FREQuency

Syntax:
AM:INTernal:FREQuency□{<frequency> | MINimum | MAXimum}
AM:INTernal:FREQuency?□[MINimum | MAXimum]

Description:
Set or query the frequency of the modulating waveform when the Internal modulation source is selected.

Return Format:
The query returns the internal modulating frequency in hertz.

Example:

AM:INT:FREQ□MIN	Set the internal modulating frequency to minimum.
AM:INT:FREQ?	Query returns the set internal modulating frequency.

6. AM:DEPTh

Syntax:
AM:DEPTh□{< depth in percent > | MINimum | MAXimum}
AM:DEPTh?□[MINimum | MAXimum]

Description:

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Set or query the internal modulation depth (or "percent modulation") in percent. MIN=0%, MAX=100%.

Return Format:
The query returns the modulation depth in percent.

Example:
AM:DEPT□MIN Set the modulation depth to minimum.
AM:DEPT? Query returns the set modulation depth.

7. AM:STATE

Syntax:
AM:STATE□{OFF | ON}
AM:STATE?

Description:
- Disable or enable AM. The default is OFF.
- Query the AM state.

Return Format:
The query returns OFF or ON.

Example:
AM:STAT□ON Enable AM modulation.
AM:STAT? Query returns ON.

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FM

In FM, the frequency of the carrier is varies with the instantaneous voltage during modulating waveform. The generator will accept an internal or external modulation source.

To generate a FM waveform you have to configure the carrier wave, choose the modulation source, select the modulation wave and its frequency, set the frequency deviation, and then enable the FM modulation.

FM commands include:

- FM:SOURce
- FM:SOURce?
- FM:INTernal:FUNCtion
- FM:INTernal:FUNCtion?
- FM:INTernal:FREQuency
- FM:INTernal:FREQuency?
- FM:DEViation
- FM:DEViation?
- FM:STATE
- FM:STATE?

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1. FM:SOURce

Syntax:
FM:SOURce□{INTernal | EXTernal}
FM:SOURce?

Description:
- Select the source of the modulating signal. The generator will accept an internal or external modulation source. The default is INT.
- Query the selected source of the FM modulating signal.

Return Format:
The query returns INT or EXT.

Example:
FM:SOUR□EXT Select external modulating signal.
FM:SOUR? Query returns EXT.

2. Select FM carrier wave

Syntax:
FUNCtion□{SINusoid | SQUare | RAMP | USER}

Description:
Select the FM carrier wave: Sine, Square, Ramp, or Arbitrary waveform. The default is Sine.

Remarks:
Pulse, Noise and DC cannot be used as AM carrier wave.

Related command:
FUNCtion

3. Set the carrier frequency

Syntax:
FREQuency□{<frequency> | MINimum | MAXimum}

Description:
Set the carrier frequency. MAX depends on the carrier wave function, MIN is always 1kHz.

Related commands:
FUNCtion
FREQuency

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4. FM:INTernal:FUNCtion

Syntax:
FM:INTernal:FUNCtion□{SINusoid | SQUare | RAMP | NRAMp | TRIangle | NOISe | USER}
FM:INTernal:FUNCtion?

Description:
Select or query the shape of the modulating waveform.

Remarks:
- The modulating waveform can be "SIN", "SQU", "RAMP", "NRAM", "TRI", "NOIS", or "USER" when the internal modulation source is selected. The default is SIN
- If the external source is chosen, it also can be used for modulating the carrier wave.

Return Format:
The query returns SIN, SQU, RAMP, NRAM, TRI, NOIS or USER.

Example:

FM:INT:FUNC□USER	Select arbitrary waveform as the modulating waveform
FM:INT:FUNC?	Query returns USER

5. FM:INTernal:FREQuency

Syntax:
FM:INTernal:FREQuency□{<frequency> | MINimum | MAXimum}
FM:INTernal:FREQuency?□[MINimum | MAXimum]

Description:
Set or query the frequency of the modulating waveform when the Internal modulation source is selected.

Return Format:
The query returns the internal modulating frequency in hertz.

Example:

FM:INT:FREQ□MIN	Set the internal modulating frequency to minimum.
FM:INT:FREQ?	Query returns the set internal modulating frequency.

6. FM:DEViation

Syntax:
FM:DEViation□{< peak deviation in Hz > | MINimum | MAXimum}
FM:DEViation?□[MINimum | MAXimum]

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Description:
Set or query the peak frequency deviation in hertz.

Return Format:
The query returns the deviation in hertz.

Example:

FM:DEV□MIN	Set the deviation to minimum.
FM:DEV?	Query returns the set deviation.

7. FM:STATE

Syntax:
FM:STATE□{OFF | ON}
FM:STATE?

Description:
- Disable or enable FM. The default is OFF.
- Query the FM state.

Return Format:
The query returns OFF or ON.

Example:

FM:STAT□ON	Enable FM modulation.
FM:STAT?	Query returns ON.

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PM

In PM, the phase of the carrier is varied by the instantaneous voltage of the modulating waveform. The generator will accept an internal or external modulation source.

To generate a PM waveform you have to configure the carrier wave, choose the modulation source, select the modulation wave and its frequency, set the phase deviation, and then enable the PM modulation.

PM commands include:

- PM:SOURce
- PM:SOURce?
- PM:INTernal:FUNCtion
- PM:INTernal:FUNCtion?
- PM:INTernal:FREQuency
- PM:INTernal:FREQuency?
- PM:DEViation
- PM:DEViation?
- PM:STATE
- PM:STATE?

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1. PM:SOURce

Syntax:
PM:SOURce□{INTernal | EXTernal}
PM:SOURce?

Description:
- Select the source of the modulation signal. The generator will accept an internal or external modulation source. The default is INT.
- Query the selected source of the PM modulation signal.

Return Format:
The query returns INT or EXT.

Example:
PM:SOUR□EXT Select external modulating signal.
PM:SOUR? Query returns EXT.

2. Select PM carrier wave

Syntax:
FUNCtion□{SINusoid | SQUare | RAMP | USER}

Description:
Select the PM carrier wave: Sine, Square, Ramp, or Arbitrary waveform. The default is Sine.

Remarks:
Pulse, Noise and DC cannot be used as PM carrier wave.

Related command:
FUNCtion

3. Set the carrier frequency

Syntax:
FREQuency□{<frequency> | MINimum | MAXimum}

Description:
Set the carrier frequency. MAX depends on the carrier wave function, MIN is always 1kHz.

Related commands:
FUNCtion
FREQuency

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4. PM:INTernal:FUNCtion

Syntax:
PM:INTernal:FUNCtion□{SINusoid | SQUare | RAMP | NRAMp | TRIangle | NOISe | USER}
PM:INTernal:FUNCtion?

Description:
Select or query the shape of the modulation waveform.

Remarks:
- The modulating waveform can be "SIN", "SQU", "RAMP", "NRAM", "TRI", "NOIS", or "USER" when the internal modulation source is selected. The default is SIN
- If the external source is chosen, it also can be used for modulating the carrier wave.

Return Format:
The query returns SIN, SQU, RAMP, NRAM, TRI, NOIS or USER.

Example:

PM:INT:FUNC□USER	Select arbitrary waveform as the modulating waveform
PM:INT:FUNC?	Query returns USER

5. PM:INTernal:FREQuency

Syntax:
PM:INTernal:FREQuency□{<frequency> | MINimum | MAXimum}
PM:INTernal:FREQuency?□[MINimum | MAXimum]

Description:
Set or query the frequency of the modulating waveform when the Internal modulation source is selected.

Return Format:
The query returns the internal modulating frequency in hertz.

Example:

PM:INT:FREQ□MIN	Set the internal modulating frequency to minimum.
PM:INT:FREQ?	Query returns the set internal modulating frequency.

8. PM:DEViation

Syntax:
PM:DEViation□{< deviation in degrees > | MINimum | MAXimum}
PM:DEViation?□[MINimum | MAXimum]

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Description:
Set or query the phase deviation in degrees.

Return Format:
The query returns the phase deviation in degrees.

Example:

PM:DEV□MIN	Set the deviation to minimum.
PM:DEV?	Query returns the set deviation.

9. PM:STATE

Syntax:
PM:STATE□{OFF | ON}
PM:STATE?

Description:
- Disable or enable PM. The default is OFF.
- Query the PM state.

Return Format:
The query returns OFF or ON.

Example:

PM:STAT□ON	Enable PM modulation.
PM:STAT?	Query returns ON.

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PWM

During Pulse Width Modulating (PWM), the width of a pulse waveform is varied with the instantaneous voltage of the modulation waveform. The generator will accept an internal or external modulation source.

To generate a PWM waveform you have to configure the carrier wave (Pulse wave), choose the modulation source, select the modulation wave and its frequency, set the pulse width and the duty cycle deviation, and then enable the PWM modulation.

PWM commands include:

- PWM:SOURce
- PWM:SOURce?
- PWM:INTernal:FUNCtion
- PWM:INTernal:FUNCtion?
- PWM:INTernal:FREQuency
- PWM:INTernal:FREQuency?
- PWM:DEViation
- PWM:DEViation?
- PWM:STATE
- PWM:STATE?

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1. PWM:SOURce

Syntax:
PWM:SOURce□{INTernal | EXTernal}
PWM:SOURce?

Description:
- Select the source of the modulating signal. The generator will accept an internal or external modulation source. The default is INT.
- Query the selected PWM modulation signal.

Return Format:
The query returns INT or EXT.

Example:
PWM:SOUR□EXT Select external modulation signal.
PWM:SOUR? Query returns EXT.

2. Select PWM carrier wave

Syntax:
FUNCtion□PULSe

Descripiton:
Choose Pulse wave as the carrier wave.

Remarks:
Only Pulse wave can be modulated in PWM.

Related command:
FUNCtion

3. Set the carrier frequency

Syntax:
FREQuency□{<frequency> | MINimum | MAXimum}

Description:
Set the carrier frequency. MAX depends on the pulse's maximum frequency, MIN is 1kHz.

Related command:
FREQuency

4. PWM:INTernal:FUNCtion

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Syntax:
PWM:INTernal:FUNCtion□{SINusoid | SQUare | RAMP | NRAMp | TRIangle | NOISe | USER}
PWM:INTernal:FUNCtion?

Description:
Select or query the shape of the modulating waveform.

Remarks:
- The modulating waveform can be "SIN", "SQU", "RAMP", "NRAM", "TRI", "NOIS", or "USER" when the internal modulation source is selected. The default is SIN
- If the external source is chosen, it also can be used for modulating the carrier wave.

Return Format:
The query returns SIN, SQU, RAMP, NRAM, TRI, NOIS or USER.

Example:

PWM:INT:FUNC□USER	Select arbitrary waveform as the modulating waveform
PWM:INT:FUNC?	Query returns USER

5. PWM:INTernal:FREQuency

Syntax:
PWM:INTernal:FREQuency□{<frequency> | MINimum | MAXimum}
PWM:INTernal:FREQuency?□[MINimum | MAXimum]

Description:
Set or query the frequency of the modulating waveform when the Internal modulation source is selected.

Return Format:
The query returns the internal modulating frequency in hertz.

Example:

PWM:INT:FREQ□MIN	Set the internal modulation frequency to minimum.
PWM:INT:FREQ?	Query returns the set internal modulation frequency.

6. PWM:DEViation

Syntax:
PWM:DEViation□{<deviation in seconds> | MINimum | MAXimum}
PWM:DEViation?□[MINimum | MAXimum]

Descripiton:
Set or query the pulse width deviation in seconds.

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Return Format:
The query returns the pulse width deviation in seconds.

Example:
PWM:DEV□MIN Set the deviation to minimum.
PWM:DEV? Query returns the set deviation.

7. PWM:STATe

Syntax:
PWM:STATe□{OFF | ON}
PWM:STATe?

Descripiton:
- Disable or enable PWM. The default is OFF.
- Query the PWM state.

Return Format:
The query returns OFF or ON.

Example:
PWM:STAT□ON Enable PWM modulation.
PWM:STAT? Query returns ON.

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FSK

In FSK modulation, you can configure the generator to "shift" its output frequency between two preset values. The rate at which the output shifts between two frequencies (called the "carrier frequency" and the "hop frequency") is determined by the internal rate generator or the signal level on the rear panel Trig In connector.

To generate a FSK waveform you have to configure the carrier wave, choose the modulation source, select the FSK "hop frequency" and the FSK rate, and then enable the FSK modulation.

FSK commands include:

- FSKey:SOURce
- FSKey:SOURce?
- FSKey:FREQuency
- FSKey:FREQuency?
- FSKey:INTernal:RATE
- FSKey:INTernal:RATE?
- FSKey:STATE
- FSKey:STATE?

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1. FSKey:SOURce

Syntax:
FSKey:SOURce□{INTernal | EXTernal}
FSKey:SOURce?

Description:
- Select an internal or external FSK source. The default is INT.
- Query the FSK source.

Return Format:
The query returns INT or EXT.

Example:
FSK:SOUR□EXT Select external FSK source.
FSK:SOUR? Query returns EXT.

2. Select FSK carrier wave

Syntax:
FUNCtion□{SINusoid | SQUare | RAMP | USER}

Description:
Select the FSK carrier wave: Sine, Square, Ramp, or Arbitrary waveform. The default is Sine.

Remarks:
Pulse, Noise and DC cannot be used as FSK carrier wave.

Related command:
FUNCtion

3. Set the carrier frequency

Syntax:
FREQuency□{<frequency> | MINimum | MAXimum}

Description:
Set the carrier frequency. MAX depends on the carrier wave, MIN is always 1kHz.

Related command:
FREQuency

4. FSKey: FREQuency

Syntax:

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FSKey: FREQuency□{<frequency> | MINimum | MAXimum}
FSKey: FREQuency?□[MINimum | MAXimum]

Description:
Set or query the FSK "hop frequency".

Return Format:
The query returns the "hop frequency" in hertz.

Example:

FSK: FREQ□MIN	Set the hop frequency to minimum.
FSK: FREQ?	Query returns the set hop frequency.

5. FSKey:INTernal:RATE

Syntax:
FSKey:INTernal:RATE□{<rate in Hz> | MINimum | MAXimum}
FSKey:INTernal:RATE?□[MINimum | MAXimum]

Description:
Set or query the rate at which the output frequency "shifts" between the carrier and hop frequency.

Return Format:
The query returns the FSK rate in hertz.

Example:

FSK:INT:RATE□MIN	Set the FSK rate to minimum.
FSK:INT:RATE?	Query returns the set FSK rate.

6. FSKey:STATE

Syntax:
FSKey:STATE□{OFF | ON}
FSKey:STATE?

Description:
- Disable or enable FSK modulation. The default is OFF.
- Query the FSK state.

Return Format:
The query returns OFF or ON.

Example:

FSK:STAT□ON	Enable FSK modulation.
FSK:STAT?	Query returns ON.

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SWEep

In the frequency sweep mode, the generator "steps" from the start frequency to the stop frequency at a sweep rate which you specify. You can sweep up or down in frequency, and with either linear or logarithmic spacing.

You can also configure the generator to output a single sweep (one pass from start frequency to stop frequency) by applying an external or manual trigger. The generator can produce a frequency sweep for sine, square, ramp, or arbitrary waveforms (pulse, noise, and dc are not allowed).

SWEep commands include:

- SWEep:SPACing
- SWEep:SPACing?
- SWEep:TIME
- SWEep:TIME?
- SWEep:STATe
- SWEep:STATe?

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1. SWEep:SPACing

Syntax:
SWEep:SPACing□{LINear | LOGarithmic}
SWEep:SPACing?

Description:
- Select linear or logarithmic spacing for the sweep. The default is Linear.
- Query current sweep mode.

Return Format:
The query returns LIN or LOG.

Example:
SWE:SPAC□LIN Set the sweep mode to "LINear".
SWE:SPAC? Query returns LIN.

2. SWEep:TIME

Syntax:
SWEep:TIME□{<seconds> | MINimum | MAXimum}
SWEep:TIME?□[MINimum | MAXimum]

Description:
Set or query the sweep time, the unit is s.

Remarks:
The sweep time is from the start frequency to the stop frequency. MIN=1ms, MAX=500s.

Return Format:
The query returns the sweep time in seconds.

Example:
SWE:TIME□MAX Set the sweep time to minimum.
SWE:TIME? Query returns the set sweep time.

3. SWEep:STATe

Syntax:
SWEep:STATe□{OFF | ON}
SWEep:STATe?

Description:
- Disable or enable the sweep mode. The default is OFF.
- Query the sweep state.

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Return Format:
The query returns OFF or ON.

Example::

SWE:STAT□ON	Enable the sweep function.
SWE:STAT?	Query returns ON.

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TRIGger

TRIGger commands are used for sweep and burst only, you can issue triggers for sweeps or bursts using internal triggering, external triggering, or manual triggering.

TRIGger commands include:

- TRIGger:SOURce
- TRIGger:SOURce?
- TRIGger:SLOPe
- TRIGger:SLOPe?
- TRIGger:DELay
- TRIGger:DELay?

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1. TRIGger:SOURce

Syntax:
TRIGger:SOURce□{IMMediate | EXTernal | BUS}
TRIGger:SOURce?

Description:
Select trigger source for the generator.

Remarks:
The generator will accept an immediate internal trigger, a hardware trigger from the rear-panel Trig In connector, or a software (bus) trigger. The default is IMM.

Return Format:
The query returns IMM, EXT or BUS.

Example:

TRIG:SOUR□EXT	Select external trigger source.
TRIG:SOUR?	Query returns EXT.

2. TRIGger:SLOPe

Syntax:
TRIGger:SLOPe□{POSitive | NEGative}
TRIGger:SLOPe?

Description:
Select whether the generator uses the rising edge or falling edge of the trigger signal on the rear-panel Trig In connector. The default is POS (rising edge).

Return Format:
The query returns POS or NEG.

Example:

TRIG:SLOP□NEG	Select falling edge.
TRIG:SLOP?	Query returns NEG.

3. TRIGger:DELay

Syntax:
TRIGger:DELay□{<seconds>| MINimum | MAXimum}
TRIGger:DELay?□[MINimum | MAXimum]

Description:
Set or query the trigger delay in seconds.

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Return Format:
The query returns the set trigger delay in seconds.

Example:

TRIG:DEL□MIN	Set the trigger delay to minimum.
TRIG:DEL?	Query returns the set trigger delay.

BURSt

You can configure the generator to output a waveform with a specified number of cycles, called a burst. The generator can produce a burst using sine, square, ramp, pulse, or arbitrary waveforms (noise is allowed only in the gated burst mode and dc is not allowed).

BURSt commands include:

- BURSt:MODE
- BURSt:MODE?
- BURSt:NCYCles
- BURSt:NCYCles?
- BURSt:INTernal:PERiod
- BURSt:INTernal:PERiod?
- BURSt:PHASe
- BURSt:PHASe?
- BURSt:STATe
- BURSt:STATe?
- BURSt:GATE:POLarity
- BURSt:GATE:POLarity?

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1. BURSt:MODE

Syntax:
BURSt:MODE□{TRIGgered | GATed}
BURSt:MODE?

Description:
Select or query the burst mode.

Remarks:
- In trigger mode, the generator outputs a waveform within a specified number of cycles (burst count) each time a trigger is received from the specified trigger source (use **TRIGger:SOURce** command).
- In the gated mode, the output waveform is either "ON" or "OFF" based on the level of the external signal applied to the rear-panel Trig In connector.
- The default is TRIG.

Return Format:
The query returns TRIG or GAT.

Example:

BURS:MODE□GAT	Set the burst mode to gated mode.
BURS:MODE?	Query returns GAT.

2. BURSt:NCYCles

Syntax:
BURSt:NCYCles□{<# cycles > | INFinity | MINimum | MAXimum}
BURSt:NCYCles?□[MINimum | MAXimum]

Description:
Set or query the number of cycles to be output per burst (triggered burst mode only). MIN=1 cycle, MAX=100,000 cycles, select INF to generate a continuous burst waveform.

Return Format:
The query returns the burst count from 1 to 100,000 or "Infinite" (for an infinite count).

Example:

BURS:NCYCles□MIN	Set the burst count to minimum.
BURS:NCYCles?	Query returns the set burst count.

3. BURSt:INTernal:PERiod

Syntax:

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BURSt:INTernal:PERiod□{<seconds> | MINimum | MAXimum}
BURSt:INTernal:PERiod?□[MINimum | MAXimum]

Description:
Set or query the burst period for internally-triggered bursts. Min=1μs, MAX=500s.

Return Format:
The query returns the burst period in seconds.

Example:
BURS:INT:PER□MAX Set the burst period to minimum.
BURS:INT:PER? Query returns the set burst period.

4. BURSt:PHASe

Syntax:
BURSt:PHASe□{<angle> | MINimum | MAXimum}
BURSt:PHASe?□[MINimum | MAXimum]

Description:
- Set the starting phase for the burst in degrees. MIN=-360 degrees, MAX=+360 degrees.
- Query the starting phase.

Return Format:
The query returns the starting phase in degrees.

Example:
BURS:PHAS□MIN Set the starting phase to minimum.
BURS:PHAS? Query returns the set starting phase.

5. BURSt:STATe

Syntax:
BURSt:STATe□{OFF | ON}
BURSt:STATe?

Description:
- Disable or enable the burst mode. The default is OFF.
- Query the burst mode.

Return Format:
The query returns OFF or ON.

Example:
BURS:STAT□ON Enable the burst mode.
BURS:STAT? Query returns ON.

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6. BURSt:GATE:POLarity

Syntax:
BURSt:GATE:POLarity□{NORMal | INVerted}
BURSt:GATE:POLarity?

Description:
Set or query the polarity of the external gate signal.

Return Format:
The query returns NORM or INV. The default is NORM.

Example:

BURS:GATE:POL□INV	Set the polarity to "INVerted".
BURS:GATE:POL?	Query returns INV.

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DATA

There are five built-in arbitrary waveforms stored in non-volatile memory. You can also store four user-defined waveforms at most in non-volatile memory in addition to one in volatile memory. Each waveform can contain between 1 and 524,288 (512k) data points. DATA commands are used for editing and storing the arbitrary wave.

The waveform data edited by users will stored in ARB1, ARB2, ARB3, ARB4, the storage is different according to the edited data points:
When 1≤data points≤128k: the waveform data will be stored in ARB1.
When 128k<data points≤256k: the waveform data will be stored in ARB1, ARB2 and
When 256k<data points≤384k: the waveform data will be stored in ARB1, ARB2, ARB3.
When 384k<data points≤512k: the waveform data will be stored in ARB1, ARB2, ARB3 and ARB4.

DATA commands include:

- DATA
- DATA:DAC
- DATA:COPY
- DATA:DELete
- DATA:CATalog?
- DATA:RENAME
- DATA:NVOLatile:CATalog?
- DATA:NVOLatile:FREE?
- DATA:ATTRibute:POINts?
- DATA:LOAD

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1. DATA

Syntax:
DATA□VOLATILE,<value>, <value >, . . .

Description:
Download floating-point values which is form -1 to 1 into volatile memory.

Remarks:
- DATA command overwrites the previous waveform in volatile memory (and no error will be generated).
- Use the **DATA:COPY**command to copy the waveform to non-volatile memory.
- Use the **DATA:DELete** command to delete the waveform in volatile memory or any of the four user-defined waveforms in nonvolatile memory.
- Use the **DATA:CATalog?** command to list all waveforms currently stored in volatile and non-volatile memory.
- After downloading the waveform data to memory, use the **FUNCtion:USER** command to choose the active waveform and the FUNC□USER command to output it.

Example:
Download seven points to volatile memory:
DATA□VOLATILE, 1, .67, .33, 0, -.33, -.67, -1

2. DATA:DAC

Syntax:
DATA:DAC□VOLATILE,<value>, <value>, . . .

Description:
Download decimal integer value which is from 0 to 16383 into volatile memory.

Remarks:
- DATA:DAC command overwrites the previous waveform in volatile memory (and no error will be generated).
- Use the **DATA:COPY**command to copy the waveform to non-volatile memory.
- Use the **DATA:DELete** command to delete the waveform in volatile memory or any of the four user-defined waveforms in nonvolatile memory.
- Use the **DATA:CATalog?** command to list all waveforms currently stored in volatile and non-volatile memory.
- After downloading the waveform data to memory, use the **FUNCtion:USER** command to choose the active waveform and the FUNC□USER command to output it.

Example:
Download seven integer points to volatile memory:
DATA:DAC□VOLATILE,0,2,4,16,32,64,128

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3. DATA:COPY

Syntax:
DATA:COPY□<destination arb name> [,VOLATILE]

Description:
Copy the waveform from volatile memory to the specified name in non-volatile memory.

Remarks:
- The arb name may contain up to 12 characters. The first character must be a letter (A-Z or a-z), but the remaining characters can be numbers (0-9) or the underscore character ("_"). Blank spaces are not allowed.
- The VOLATILE parameter is optional and can be omitted. Note that the keyword "VOLATILE" does not have a short form.
- The following built-in waveform names are reserved and cannot be used with the DATA:COPY command: "EXP_RISE", "EXP_FALL", "NEG_RAMP", "SINC", and "CARDIAC". If you specify one of the built-in waveforms, a error is generated.
- Use the **DATA:DELete** command to delete the waveform in volatile memory or any of the four user-defined waveforms in non-volatile memory.
- Use the **DATA:CATalog?** command to list all waveforms currently stored in volatile and non-volatile memory. The default selection is EXP_RISE.

Example:
Copy the VOLATILE waveform into named storage "ARB1".
DATA:COPY□ARB1, VOLATILE

4. DATA:DELete

Syntax:
DATA:DELete□<arb name>

Description:
Delete the specified arbitrary waveform from memory. You can delete the waveform in volatile memory or any of the four user-defined waveforms in non-volatile memory.

5. DATA:CATalog?

Query:
DATA:CATalog?

Description:
List the names of all waveforms currently available for selection.

Return Format:
Returns the names of the five built-in waveforms (non-volatile memory), "VOLATILE"

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(if a waveform is currently downloaded to volatile memory), and all user-defined waveforms downloaded to non-volatile memory.

6. DATA:RENAME

Syntax:
DATA:RENAME□<destination arb name>,<new arb name>

Description:
Rename an arbitrary wave.

7. DATA:NVOLatile:CATalog?

Syntax:
DATA:NVOLatile:CATalog?

Description:
List the names of all user-defined arbitrary waveforms downloaded to non-volatile memory.

Return Format:
Return the quoted names of up to four waveforms.

Example:
"00","01","10","11"

8. DATA:NVOLatile:FREE?

Query:
DATA:NVOLatile:FREE?

Description:
Query the number of non-volatile memory slots available to store user-defined waveforms.

Return Format:
Returns the number of memory slots available to store user-defined waveforms.

Example:
Returns 0 (memory is full), 1, 2, 3 or 4.

9. DATA:ATTRibute:POINts?

Query:
DATA:ATTRibute:POINts?□[<destination arb name>]

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Description:
Query the number of points in the specified arbitrary waveform.

Return Format:
Returns a value which is from 0 to 524,288. The default arb name is the arbitrary waveform currently active (selected with **FUNCtion:USER** command).

10. DATA:LOAD

Syntax:
DATA:LOAD□[<destination arb name>]

Description:
Upload the specified arbitrary wave to the application software (UltraWave).

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MEMory

The generator has five storage locations in non-volatile memory to store instrument states. The locations are numbered 0 through 4. The generator automatically uses location "0" to hold the state of the instrument at power down. You can also assign a user-defined name to each of the locations (1 through 4) for use from the front panel.

MEMory commands include:

- MEMory:STATe:NAME
- MEMory:STATe:NAME?
- MEMory:STATe:DELete
- MEMory:STATe:RECall:AUTO
- MEMory:STATe:RECall:AUTO?
- MEMory:STATe:VALid?
- MEMory:NSTates?

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1. MEMory:STATe:NAME

Syntax:
MEMory:STATe:NAME□{0 | 1 | 2 | 3 | 4} [,<name>]
MEMory:STATe:NAME?□{0 | 1 | 2 | 3 | 4}

Description:
- Assign a user-defined name to the specified storage location.
- Query the name of the specified storage location.

Return Format:
The query returns a string containing the name currently assigned to the specified storage location. If you have not assigned a user-defined name to the specified location, it will return a null string.

2. MEMory:STATe:DELete

Syntax:
MEMory:STATe:DELete□{0 | 1 | 2 | 3 | 4}

Description:
Delete the contents of the specified storage location.

3. MEMory:STATe:RECall:AUTO

Syntax:
MEMory:STATe:RECall:AUTO□{OFF | ON}
MEMory:STATe:RECall:AUTO?

Description:
Disable or enable the automatic recall of the power-down state from storage location "0" when power is turned on. Select "ON" to automatically recall the power-down state when power is turned on. Select "OFF" (default) to issue a reset when power is turned on.

Return Format:
The query returns OFF or ON.

4. MEMory:STATe:VALid?

Query:
MEMory:STATe:VALid?□{0 | 1 | 2 | 3 | 4}

Description:
Query the specified storage location to determine if a valid state is currently stored in that location.

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Return Format:
Return "0" if no state has been stored or if it has been deleted. Return "1" if a valid state is stored in the specified location.

5. MEMory:NSTates?

Query:
MEMory:NSTates?

Description:
Query the total number of memory locations available for state storage.

Return Format:
Always returns "5" (memory location "0" is included).

SYSTem

This section gives information on topics such as instrument state storage, power-down recall, error conditions, and front-panel display control. This information is not directly related to waveform generation but is an important part of operating the generator.

SYSTem commands include:

- *IDN?
- SYSTem:ERRor?
- SYSTem:VERSion?
- SYSTem:BEEPer:STATe
- SYSTem:BEEPer:STATe?
- SYSTem:LOCal
- SYSTem:RWLock
- SYSTem:REMote
- SYSTem:LANGuage

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1. *IDN?

Syntax:
*IDN?

Description:
Read the generator's identification string which contains four fields separated by commas. The first field is the manufacturer's name, the second field is the model number, the third field is the serial number, and the fourth field is a revision code which contains characters and numbers separated by dot.

Return Format:
RIGOL TECHNOLOGIES,DG2041A,DG2A091400228,0019AF080019,,03.13.070

2. SYSTem:ERRor?

Syntax:
SYSTem:ERRor?

Description:
Read and clear error from the generator's error queue.

Return Format:
-110,"Undefined command word"

3. SYSTem:VERSion?

Syntax:
SYSTem:VERSion?

Description:
Query the generator to determine the present SCPI version.

Return Format:
Return a string: 04.06.00.03

4. SYSTem:BEEPer:STATe

Syntax:
SYSTem:BEEPer:STATe□{OFF | ON}
SYSTem:BEEPer:STATe?

Description:
- Disable or enable the tone heard when an error is generated from the front-panel or over the remote interface.
- Query the beeper state.

Return Format:
The query returns OFF or ON.

5. SYSTem:LOCal

Syntax:
SYSTem:LOCal

Description:
Set the instrument state to local. Remove the "Rmt" sign and unlocks the front panel keyboard.

6. SYSTem:RWLock

Syntax:
SYSTem:RWLock

Description:
Set the instrument state to remote with lock. Display the "Rmt" sign and locks the keyboard (including the "Local" key).

7. SYSTem:REMote

Syntax:
SYSTem:REMote

Description:
Set the instrument state to remote. Display the "Rmt" sign and locks the keyboard (except the "Local" key).

8. SYSTem:LANGuage

Sytax:
SYSTem:LANGuage□{CHINESE | ENGLISH}

Description:
Select the display language.

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PHASe

PHASe command is used to set the phase offset of the output waveform.

SYSTem commands include:

- PHASe
- PHASe?

1. PHASe

Syntax:
PHASe□{<angle> | MINimum | MAXimum}
PHASe?□[MINimum | MAXimum]

Description:
Adjust the phase offset of the output waveform in degrees. MIN = 0 degrees. MAX = +360 degrees.

Return Format:
The query returns the phase offset in degrees. The default is 0 degrees.

Example:

PHAS□MIN	Set the phase offset to minimum.
PHAS?	Query returns 0.000.

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DISPlay

DISPlay commands are used for controlling the front panel display.

DISPlay commands include:

- DISPlay
- DISPlay?
- DISPlay:LIGHTLEV

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1. DISPlay

Syntax:
DISPlay□{OFF | ON}
DISPlay?

Description:
- Disable or enable the generator front-panel display.
- Query the display mode.

Remarks:
When it is disabled, the front-panel display is blanked (however, the bulb used to backlight the display remains enabled).

Return Format:
The query returns OFF or ON.

2. DISPlay: LIGHTLEV

Syntax:
DISPlay:LIGHTLEV□<value>

Description:
Set the light level of the display between 0 and31.

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Chapter 3 Application Examples

This chapter is going to introduce you how to control DS2000 series via commands with some examples.

- To generate a sine waveform
- To generate an AM modulation waveform
- To generate a built-in Random waveform
- To generate a Linear sweep waveform
- To generate a burst waveform

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To Generate a Sine Waveform

The following text will guide you to generate a sine waveform with 20 kHz frequency, 2.5 Vpp amplitude and 0Vdc offset.

How to realize Remote control via commands:

Method1:

0	*IDN?	/*To Query ID number of instrument and check the operating status*/
1	APPL: SIN□20000, 2.5,0	/*To output a sine waveform with 20 kHz frequency, 2.5 Vpp amplitude and 0Vdc offset Vdc*/
2	OUTP□ON	/*To open OUTPUT connector*/

Method2:

0	*IDN?	/*To Query ID number of instrument and check the operating status*/
1	FUNC□SIN	/*To setup the output of Generator as sine waveform */
2	FREQ□20000	/*To setup the output frequency as 20 kHz */
3	VOLT□2.5	/*To setup the amplitude as 2.5 */
4	VOLT: UNIT□VPP	/*To setup the unit of amplitude as Vpp */
5	VOLT: OFFSet□0	/*To setup the offset as 0*/
6	OUTP□ON	/*To open OUTPUT connector */

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To Generate an AM Waveform

The following text will guide you to generate an AM waveform with 70% modulation depths. Within 2.5 kHz of carrier wave, the modulating waveform adopts internal sine waveform with 150 Hz.

How to realize Remote control via commands:

0	*IDN?	/*To query ID number of instrument and check the operating status*/
1	FUNC□SIN	/*To select carrier wave*/
2	FREQ□25000	/*To select frequency of carrier wave*/
3	AM:STAT□ON	/*To enable AM modulation*/
4	AM:SOUR□INT	/*To select internal modulation source*/
5	AM:INT:FUNC□SIN	/*To select modulation function*/
6	AM:INT:FREQ□150	/*To select modulation frequency*/
7	AM:DEPT□70	/*To setup modulation depth*/
8	OUTP□ON	/*To open OUTPUT connector */

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To Generate a Build-In Arbitrary Waveform

The following text will guide you to generate a SINC waveform with 8MHz of frequency, 5Vrms of Amplitude and 0 offset.

How to realize Remote control via commands:

0	*IDN?	/*To query ID number of instrument and check the operating status*/
1	FUNC:USER□SINC	/*To select carrier wave*/
2	VOLT:UNIT□VRMS	/*To select unit of output amplitude*/
3	APPL:USER□8000000,5,0	/*To output a waveform with selected parameters*/
4	OUTP□ON	/*To open OUTPUT connector*/

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To Generate a Linear Sweep Waveform

The following text will guide you to generate a Sweep sine waveform adopts internal sweep trigger and linearity sweep within 10s from 100Hz to 10 kHz.

How to realize Remote control via commands:

```
0  *IDN?                  /*To query ID number of instrument and check
                          the operating status*/
1  FUNC□SIN               /*Select sweep function*/
2  SWE:SPAC□LIN           /*Select sweep mode*/
3  SWE:TIME□10            /*Select sweep time*/
4  FREQ:STAR□100          /*Select start frequency*/
5  FREQ:STOP□10000        /*Select stop frequency*/
6  OUTP□ON                /*To Open OUTPUT connector*/
```

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To Generate a Burst Waveform

The following text will guide you to generate a burst waveform with three cycles. The period is 10ms.

How to realize Remote control via commands:

```
0  *IDN?                    /*To query ID number of instrument and check
                            the operating status*/
1  FUNC□SQUA                /*To select burst function*/
2  BURS:STAT□ON             /*To start burst output*/
3  BURSt:MODE□TRIG          /*To select burst mode*/
4  BURS:NCYCles□3           /*To setup cycle number of burst*/
5  BURS:INT:PER□0.01        /*To select period of burst*/
6  OUTP□ON                  /*To open OUTPUT connector*/
```


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